Concordance of Pathophysiological Responses in Mice Exposed to Different Biomass Smoke Conditions via Aspiration and Inhalation

Yong Ho Kim[1], Charly King[1], Q. Todd Krantz[1], Ingrid J. George[2], Marie M. Hargrove[3], Lisa Copeland[1], Michael D. Hays[2], Matthew S. Landis[4], Mark Higuchi[1], Stephen H. Gavett[1], M. Ian Gilmour[1]

[1]NHEERL, [2]NRMRL, [3]ORISE, and [4]NERL, US EPA, Research Triangle Park, NC, USA

We have previously reported that aspiration of an equal mass (100 µg) of particulate matter (PM) in flaming biomass smoke condensate caused greater lung toxicity in mice than samples from smoldering smoke. In this study, we conducted inhalation exposures on a subset of the biomass smoke fuels and conditions, and compared with the previous results before and after dosimetric adjustment for inhaled PM. Biomass smoke from peat, eucalyptus and oak fuels was generated under smoldering and flaming phases with PM levels precisely maintained by an automated smoke emission controlling system. Mice were exposed for 1 hour/day for 2 days and then assessed for lung toxicity at 4 and 24 h after the second exposure. PM levels were ~40 and ~4 mg/m^3 from the smoldering and flaming phases, respectively, while carbon monoxide (CO) levels ranged between ~60 to 110 ppm depending on the fuel and combustion conditions. Total inhaled PM in the mouse lungs during the exposure was estimated to be ~130 and ~13 µg PM, for smoldering and flaming respectively. Peat smoke produced under either combustion conditions caused similar increases in neutrophil (PMN) influx at both time points despite the flaming PM concentration being 10-fold lower. PMN responses to smoldering eucalyptus were higher than flaming at 4 h although effects were equivalent for both conditions by 24 h. A significant increase in ventilator timing (as measured by Penh), potentially indicating airflow obstruction, was observed in mice exposed to flaming peat and for both flaming and smoldering eucalyptus immediately after each day of exposure, in agreement with the inflammation results. No pathophysiological responses were seen following exposure to either combustion condition of oak, which mirrored the responses following aspiration exposure. Overall the results show good concordance in responses between aspiration and inhalation studies depending on type of fuel and combustion conditions and confirm that PM from flaming condition is, on a mass basis, more toxic than that from smoldering smoke. [This abstract does not represent EPA policy]